

XMM-Newton CCF Release Note

XMM-CAL-SRN-0325

X-ray Loading correction for EPIC-pn Burst Mode

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1 CCF components

Name of CCF	VALDATE	EVALDATE	Blocks changed	XSCS flag
EPN_REJECT_0008.CCF	2002-07-07		XRL2PHA	NO

In 2010, it was discovered that Timing Mode exposures are affected by X-ray loading (XRL). Until 23rd of May 2012, the offset maps were always taken with the same science filter as the observation itself, and the astrophysical source contaminated the offset map in a rate dependant way. For the Timing Mode, the effect is illustrated in Fig.2 of Guainazzi & Smith (2013, XMM-CAL-SRN-0302), and for the Burst Mode, the residual offsets are illustrated in Fig. 1.

This CCF constituent includes an update of the XRL2PHA extension of the EPIC-pn REJECT CCF that controls the X-ray loading (XRL) correction for both, EPIC-pn Timing and Burst Mode. The implementation of XRL correction for EPIC-pn Timing Mode is described in Guainazzi & Smith (2013). The extension XRL2PHA was first introduced in EPN_REJECT_0006.CCF (Guainazzi et al. 2012), containing the parameters a and b in the relation

$$\Delta PHA = a + b \times XRL \quad (1)$$

with ΔPHA being the shift in energies, applied to the PHA column, and XRL is the offset derived from the offset map while the parameters a and b were initially filled with zero values, i.e., no correction. Comparisons of energy shifts of the Crab derived from observations in which the offset map was built with open and closed filters showed a linear relation between X-ray loading from the source and the offset from the offset map. With EPN_REJECT_0007.CCF (Guainazzi & Smith 2013), the parameters $a = 0$ and $b = 1$ have thus been added for the Timing Mode while being left at zero for the Burst Mode. Version EPN_REJECT_0008.CCF now contains non-zero values for a and b for the Burst Mode.

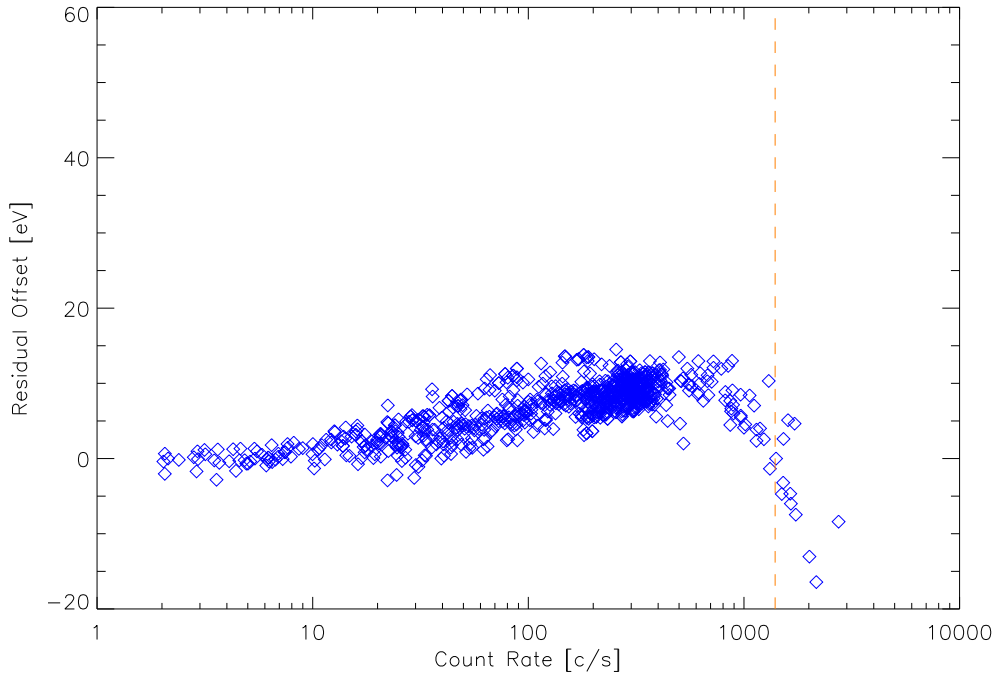
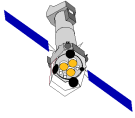


Figure 1: Illustration of X-ray loading effects in the offset maps caused by the source if taken with science filters. The dashed vertical line indicates the nominal pre-launch XRL threshold.

2 Changes

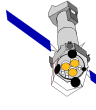
After testing various combinations of parameters a and b for Burst Mode, the resulting correction turned out to be small as can be expected from Fig. 1. As a result, the same parameters as for the Timing Mode have been included in order to account for the offset maps that have been shown to contain X-ray loading in Guainazzi et al. (2012). The full contents of XRL2PHA are summarized in the table below.

Contents of XRL2PHA extension of EPN_REJECT_0008.CCF

	MODE	CCD	COEFF	
Timing	4	4	0	1
Burst	5	4	0	1

3 Scientific Impact and estimated Scientific Quality of this Update

The correction for X-ray loading on the offset maps requires a recalibration of the Rate Dependant Charge Transfer Inefficiency (RDCTI) correction which is described in the accompanying release note Ness et al. (2015). The two corrections need to be applied sequentially, first XRL correction, the RDCTI correction, and the scientific impact and estimated scientific quality of the combined corrections are discussed in this accompanying release note.



4 References

Guainazzi M., et al. 2012, XMM-SOC-CAL-SRN-0281,
"Support to the X-ray Loading correction in EPIC-pn Fast Modes"
(available at: <http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0281-1-0.pdf>)

Guainazzi M. & Smith M. 2013, XMM-SOC-CAL-SRN-0302,
"Calibration of the spectral impact of X-Ray Loading (XRL) in EPIC-pn Timing Mode"
(available at: <http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0302-1-5.pdf>)

Ness, J.U., Guainazzi M. and Smith M. 2015, XMM-CCF-REL-0326,
"X-ray Loading and Rate-Dependent CTI correction for EPIC-pn Burst Mode"
(available at: <http://xmm2.esac.esa.int/docs/documents/CAL-SRN-0326-1-1.pdf>)